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A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials.

Technical field

The subject of the present invention is a metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials.

Technological background

Volumetric metering devices are used widely in many different technical fields in which there is a need to deliver a substantially continuous and measured flow of material over time. For example, the technical field of agricultural sowing machines with pneumatic seed-transportation is typical; in these machines it is known to provide a seed-loading hopper at the base of which a metering device, generally of the volumetric type with blades, is fitted and supplies metered quantities of seeds into a Venturi duct by which the seeds are admitted to an air-flow and transported to the sowing drills.

The particular and preferred application of the invention is in all cases in which it is necessary to vary the flow-rate delivered, possibly within a fairly large range of values.

Typical metering devices formed in accordance with the prior art are described, for example, in EP 0702890, EP 0606541, EP 0471155, and US-A-6138591.

Conventional metering devices normally comprise a box-like structure in which a bladed metering member is supported rotatably and cooperates with a flow-restricting device for regulating the flow-rate delivered. In one example, the restricting device comprises a jacket movable axially in adjustable manner relative to the rotor of the distributor so as to cover a portion of the set of blades in order to reduce the overall capacity of the cells available. Alternatively, the rate of rotation of the metering member may be varied, or the capacity of the cells may be varied.

A first problem resulting from the known structure of conventional distributors is that they do not permit large adjustments of flow-rate whilst maintaining constant regulation of the metering for each adjustment. In fact there are critical speeds of the metering member beyond which its reliability is reduced.

A second problem typical of known structures is that they comprise a plurality of parts which have to be assembled by means of connections, screws, flanges etc. This philosophy is rather unsuitable for agricultural machines for which many adjustments have to be performed in the field and the consequent 5 need to remove various parts may lead to their loss, making reassembly impossible.

A further problem characteristic of metering devices is that they are subject to irremediable damage, or at least to blockage of the metering member, when foreign bodies of considerable size reach its rotor. In the absence of a timely 10 indication of this situation, particularly during sowing, it is possible, completely unwittingly, to sow whole fields unevenly or not at all.

Description of the invention

These problems and yet others which will become clearer from the following description are addressed and solved by the invention by means of a 15 metering device formed in accordance with the appended claims.

Brief description of the drawings

The characteristics and the advantages of the invention will become clearer from the detailed description of a preferred but not exclusive embodiment described by way of non-limiting example, with reference to the appended 20 drawings, in which:

- Figure 1 is a schematic view showing, in section, the basic components of a machine for distributing granular materials,
- Figure 2 is an exploded, perspective view of a delivery device formed in accordance with the present invention,
- 25 - Figure 3 and Figure 4 are exploded views of respective variants of a detail of the device of Figure 2,
- Figures 5, 6 and 7 are perspective views of the device of Figure 2 in the assembled condition, taken from different angles,
- Figures 8 and 9 are perspective views of the device of Figure 2 in an only 30 partially assembled condition, taken from different angles,
- Figure 10 is a perspective view of a detail of the device of Figure 2, on an enlarged scale, and
- Figure 11 is a side view of a further detail of the device of Figure 2.

Preferred embodiment of the invention

With reference to Figure 1, a machine for distributing granular materials, usable both for sowing seeds and for spreading manure, disinfectants etc., is generally indicated 1. The machine 1 comprises, basically, one or more hoppers 5 2 for holding the material to be spread, a blower 3 which delivers an air-flow under pressure to an air injector 4, a metering device 5 which supplies metered quantities of the material present in the hopper into the air-flow generated by the blower 3, and a distributor 6 which distributes the mixed flow of air and material transported thereby towards distribution ducts 7.

10 The metering device 5 can advantageously be constructed in accordance with one or more of the teachings of the present invention and is shown in detail in Figure 2 and the subsequent figures.

15 The device comprises a housing 10 which, by virtue of the provisions of the invention, can advantageously be constructed in a single piece by moulding of plastics material. The housing 10 comprises a first, upper opening 11 which is open towards the hopper 2, a second, rear opening 12, closed in an openable manner by a removable door 14, and an opposed, third opening 15 which admits the granular material to the region of the air injector. The housing is closed at the bottom by a feeler member 16 which will be described further below.

20 The housing 10 further comprises opposed side walls 17 having two circular and coaxial through-holes 18. The holes serve for housing a metering member, generally indicated 20, in the housing 10.

25 The metering member 20 comprises a shaft 21 of polygonal, preferably square, cross-section, having, at one end, a joint 22 by means of which it can be coupled for rotation with a drive shaft (not shown) and, at the other, opposite end, a threaded shank 23 onto which a hand wheel 24 is screwed with the interposition of a washer 25. The assembly serves to clamp to the shaft 21 a plurality of metering wheels 26, included in a group between two flanges 27 and intercalated with discs 28.

30 The flanges 27 are identical to one another and each has two external tracks 29a, 29b which serve to support the metering member in the housing 10 rotatably but with axial restraint. Support is achieved by means of three or more bearings 30a, 30b, 30c, the outer portions of which are in rolling contact with one

or other of the tracks 29a, 29b. The axial restraint is not actually necessary for the operation of the device since the shaft 21 is itself fixed axially relative to the housing as a result of its connection to the drive shaft by means of the joint 22. However, to prevent the metering member 20 from accidentally coming out of the 5 housing 10 when the device is released from the drive shaft, the tracks 29a, 29b have different diameters (the track 29a, closer to the side wall of the housing, has a larger diameter) and one bearing 30a is fixed to the housing 10 removably by means of the hand wheel 32 and is engaged on the track 29b so that the shoulder existing between the two tracks performs the desired axial restraint. In order to 10 remove the metering member from the housing, the hand wheel 32 is slackened, removing the bearing 30a and with it the axial restraint preventing the metering member from slipping out.

Both of the flanges, or at least one of them, may have a ring of axial seats 33 for cores (for examples, screws) cooperating with a proximity detector (not 15 shown) in order to measure the rate of rotation of the metering member 20.

Each metering wheel 26 is moulded of plastics material and comprises a plurality of blades 36 which extend radially from a hub 37 having an axial hole 37a with a channelled profile in which the channels have a profile which can be coupled with the shaft 21 and the number of channels is a multiple of the number 20 of sides of the shaft so as to permit different angular positionings of the wheels 26 on the shaft 21. The wheels can thus be mounted in a manner such that they are offset angularly relative to one another, improving the uniformity of the output.

Both to take account of this angular offset and to strengthen the blades at their free ends, axial appendages 38 are provided thereon and are housed in 25 corresponding holes 39 in the discs 28. The discs 28 have circular holes and are not otherwise driven by the shaft 21.

The wheels 26 are interchangeable with second wheels 26a of different volumetric capacity or even with third wheels 40 of low volumetric capacity, which can also be mounted on the shaft 21 with the interposition of a release 30 mechanism 41 (see Figures 3 and 4). One or more of the third wheels 40 can thus be disconnected from the drive of the shaft simply by being turned through 180°. In one direction, the mechanism 41 in fact brings about driving of the wheel 40 together with the shaft 21, whereas in the opposite direction, the mechanism

41 is disengaged from the shaft 21, rendering the wheel 40 idle. Moreover, for intermediate capacities, the first and second wheels 26, 26a, may be combined in the metering member 20, by being arranged alternately in the group of wheels.

A particular problem which is solved by the invention lies in the fact that

- 5 some minute seeds with a high oil content (typically rape seeds) tend to release greasy substances into the cells of the metering wheels (and into the metering device in general), changing its capacity (to the extent of reducing it to zero). This specific problem has been solved by the invention by means of a special scraper device 50 which is mounted downstream of the region in which the seeds fall.
- 10 The scraper 50 comprises a shaft 50a on which bow-shaped metal scraper members 51, for example, of harmonic steel, are mounted; the number of scraper members 51 corresponds to the number of wheels 40. Each scraper member has a crosspiece 52 which can follow the profiles of the cells, deforming the corresponding bow resiliently whilst the wheel 40 rotates. The shaft 50a is in turn
- 15 rotatable on the housing between two positions in which the scraper members are disengaged from the wheels or, conversely, are engaged in contact therewith, respectively. Oily residues which tend to stick to the seeds and to the ever-present dust, are thus removed and fall into the pneumatic seed-conveyor duct in order to be removed from the device 5.

- 20 Again, with oily seeds, in spite of the provision of release mechanisms, one or more of the wheels which are intended to be rendered idle by being turned around on the shaft 21 may nevertheless be rotated as a result of the internal friction which is increased by the presence of residues of dirt. To prevent this occurring, the wheels 40 according to the present invention have, in one or more
- 25 of the cells formed in their surfaces between adjacent blades, respective tooth-like formations 54 which, in one direction of rotation, offer the crosspieces 52 of the scraper members an inclined rear face 55 on which the crosspiece 52 does not grip whereas, in the other direction of rotation, they offer the crosspiece 42 a substantially radial leading face with which the crosspiece 52 engages, preventing
- 30 further driving of the wheel 40. An example of this function relates to the central wheel of Figure 10.

The ability to release the scrapers from the wheels 40 when they are not required considerably reduces wear of the scrapers, maintaining their effective life.

A further advantageous aspect of the invention lies in the structure and functional capacity of the feeler member 16. In known solutions, this member is generally constituted by a pivoting scraper blade provided with a resilient rubber lip. The main disadvantages resulting from this structure are connected with the 5 fact that, with variations in the rate of rotation of the metering member, the rubber lip deforms, varying the flow-rate of the device in a non-predetermined manner. Moreover, the passage of any foreign body (a stone or the like) can block its pivoting in the open position, with a consequent unexpected change in the metering.

10 The feeler member 16 according to the invention comprises a plurality of individual feeler elements 60, each having a first end engaged on a shaft 61 and each carrying, at its opposite end, a fork 62 which houses a further shaft 63 with predetermined clearance. The fork prong 66 facing the metering member 20 carries a resilient lip 67. Both of the shafts 61, 63 are supported between the side 15 walls 17 of the housing 10.

The feeler elements 60 are spaced apart by fixed plate-shaped separators 68, which are also articulated on the shaft 61 at one end and engage the shaft 63 with their opposite ends, but without the ability to pivot about the shafts.

20 In the region of the fork 62, there are resilient preloading means, each including a helical spring 64 and a respective stay 65, which urge the respective feeler element 60 towards the corresponding metering wheel. However, the feeler element is kept spaced therefrom by the interaction of the corresponding prong of the fork 62 with the shaft 63. Alternatively, similar resilient preloading means are arranged to be active at the opposite end of each feeler element. It is thus 25 possible to apply to the elements 60 a predetermined resilient preloading, preferably of the order of about 1.5 kg, without this leading to compression of the lip 67 against the metering member which, in conventional systems, is a potential cause of rupture of the seeds distributed. On the other hand, the feeler elements can perform oscillations about the shaft 61 which are limited by the other prong of 30 the fork 62 so as to prevent the feeler member from opening completely, significantly altering the distribution parameters. This precaution is augmented by the provision of individual and independent feeler elements for each wheel.

With these means for limiting the pivoting of the feeler member, breakages of the feeler elements could occur should foreign bodies of dimensions larger than the maximum opening between the feeler elements and the respective wheels pass through the metering member. To prevent this, according to a further 5 characteristic of the invention, each separator 68 is arranged to have a nib 69 of a shape and size such as to alter the angle of introduction between the feelers and the metering member 20 so that foreign bodies arriving in the introduction opening between the feelers and the metering body are "rejected" by virtue of the increased amplitude of the angle of introduction as defined above and are 10 prevented from entering the introduction opening. By way of indication, the angle of introduction as varied by the provision of the nibs 68 is about 80°.

According to a further characteristic of the invention, flow separator means 70 may be arranged in the region of the opening 15 for admitting the granular material into the air-flow which is responsible for its transportation. These 15 separator means 70 are of the type comprising a fixed plate supported, by means of notches 71, on shafts 72, 73 extending between the side walls 17 of the housing 10. The shaft 72 also serves to support respective surfaces for collecting the seed and sending it to the air-injection duct 4.

On the side facing the metering member, the separator plate 70 has an 20 arcuate profile 74 complementary with the outer surface of a toothless wheel 75 which is fitted centrally between the metering wheels. It is thus possible, with a single metering device, to supply two distributors and respective blowers separately, in fact doubling the capacity of the distributing machine.

According to an additional characteristic of the invention, second separator 25 means 76 may be disposed in the housing, upstream of the metering member 20, so as to separate, not only at the output but also at the input, products which may optionally be different and which can be metered by a single metering device. The second separator means 76 comprise a fixed plate, also provided with an arcuate profile 77 complementary with the surface of the toothless wheel 75, and 30 having teeth 78 for engagement on a plate 79 which is equipped with two doors 80 and can replace the door 14 when this arrangement is selected. Amongst the advantages conferred by this technical solution is the fact that it is possible to distribute different products through the right-hand and left-hand sides of the

same metering device. For example, it is possible to construct sowing machines with double seed-loading hoppers and a single metering device suitable, for example, for sowing alternating bands of male and female plants for the production of selected hybrids. That is, it is possible to distribute different 5 products simultaneously, optionally with different metering, adjustable in dependence on the type of metering wheels used for the right-hand and left-hand sides.

Finally, a stirrer 81 is provided, supported rotatably between the side walls 17 of the housing 10 and rotated by the joint 22, by means of a belt transmission 10 82.

The metering device of the present invention thus achieves the objects indicated, at the same time offering many advantages over the prior art, amongst which is greater ease of handling during operations to assemble and dismantle the individual components.